



Electroweak & BSM Physics at the EIC

Welcome & Context for this Workshop

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Stony Brook University & Brookhaven National Laboratory

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1st Fully Remote Workshop at the Center for Frontiers in Nuclear Science

In this time of world-wide Corona-Virus crisis, let us all show solidarity with our friends and colleagues around the world who are struggling and yet fighting with the virus.

We wish them the best to be safe, healthy & strong and remain that way for the remainder of this pandemic.

Center for Frontiers in Nuclear Science



<http://www.stonybrook.edu/cfns>

History:

- Established in Fall 2017 with generous support from the **Simons Foundation** and the **SUNY/NY State**
- Joint initiative by Stony Brook University & Brookhaven National Lab

Vision:

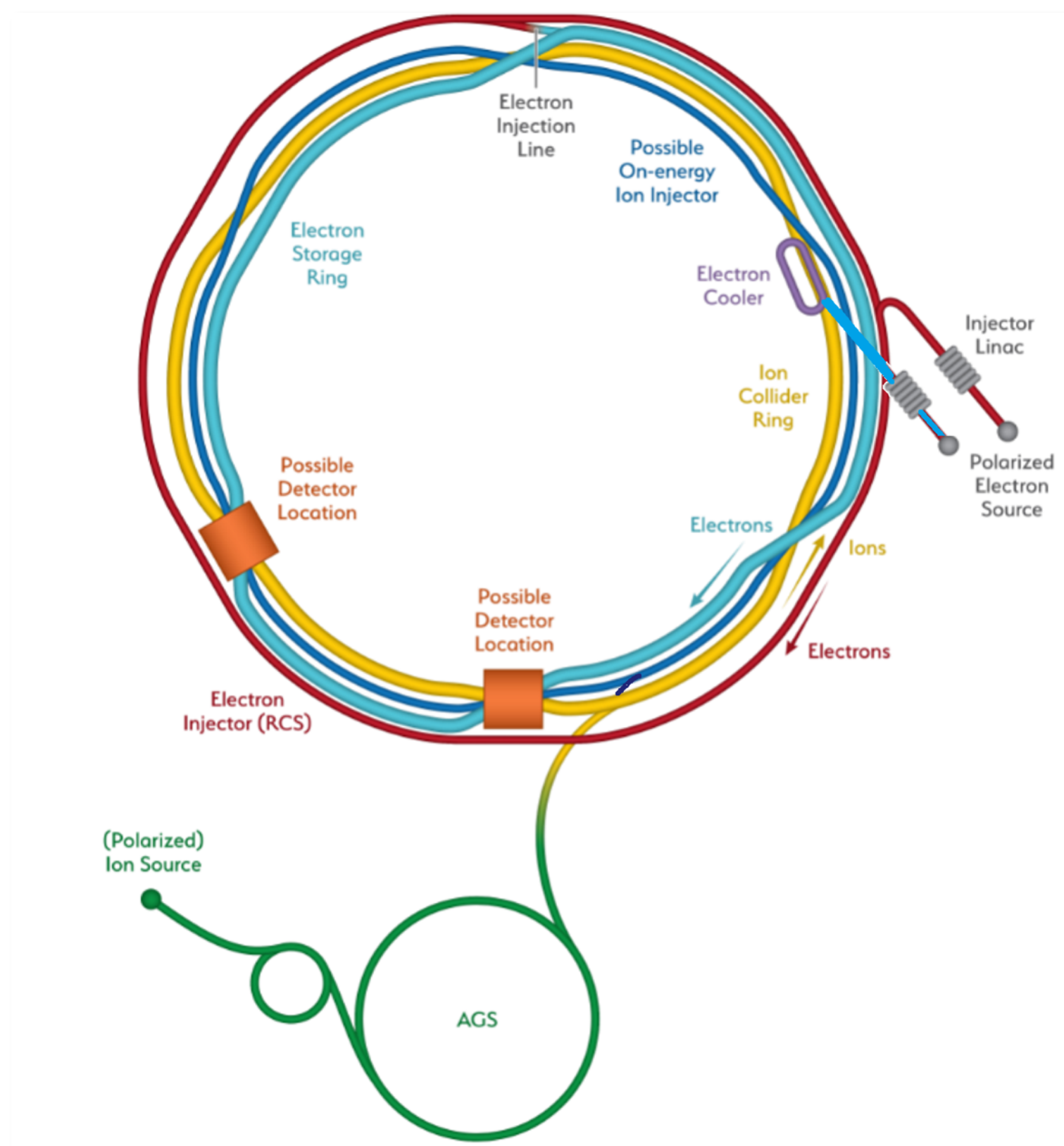
- To support and help the EIC user community to enhance the case for the EIC.
- Invest in, train and support young scientists in the field to work on EIC

Scientific Activities & Operations:

Reviewed annually by an International Advisory Committee, a Physics Advisory Committee and a local Steering Committee

- 4 Workshops & 4-5 adhoc meetings
- Post doctoral program:
 - ~8-10 post docs (local)
 - ~5 joint post docs w/ remote institutions
- Bi-monthly Seminars
- Visitor programs
- Summer schools
- Supporting EIC conferences and meetings

The Electron Ion Collider Project moves forward

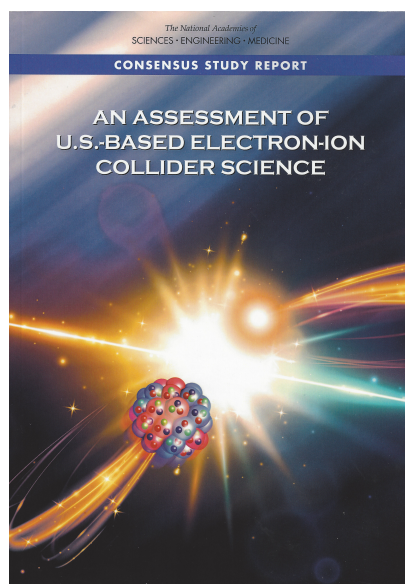


Electron Ion Collider (EIC) remains on a fast track moving forward through various technical , organizational and administrative.

Science program broadens and deepens

Talks today by Christoph Montag & Douglas Higinbotham

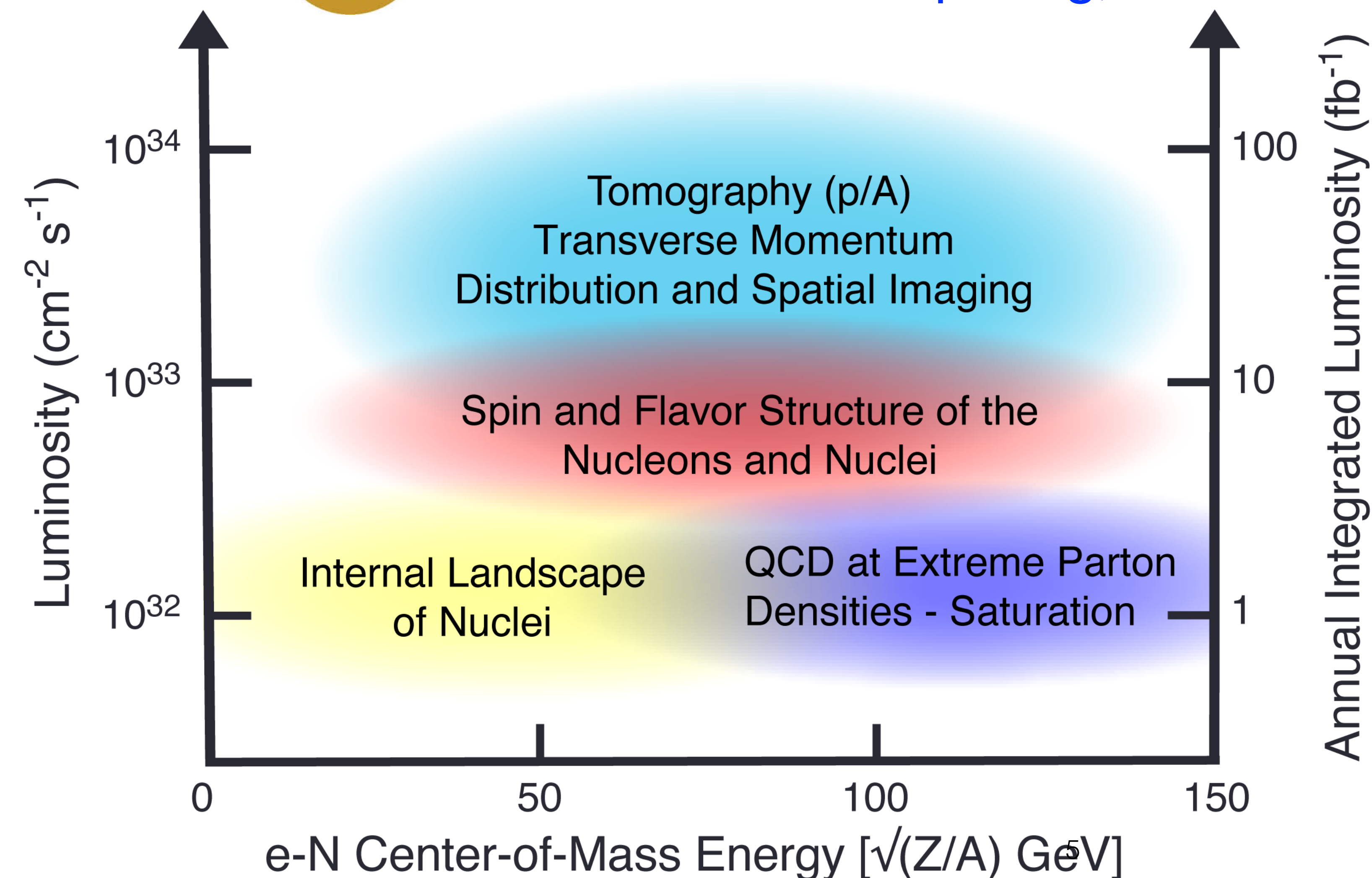




EIC Physics

NAS Consensus Report

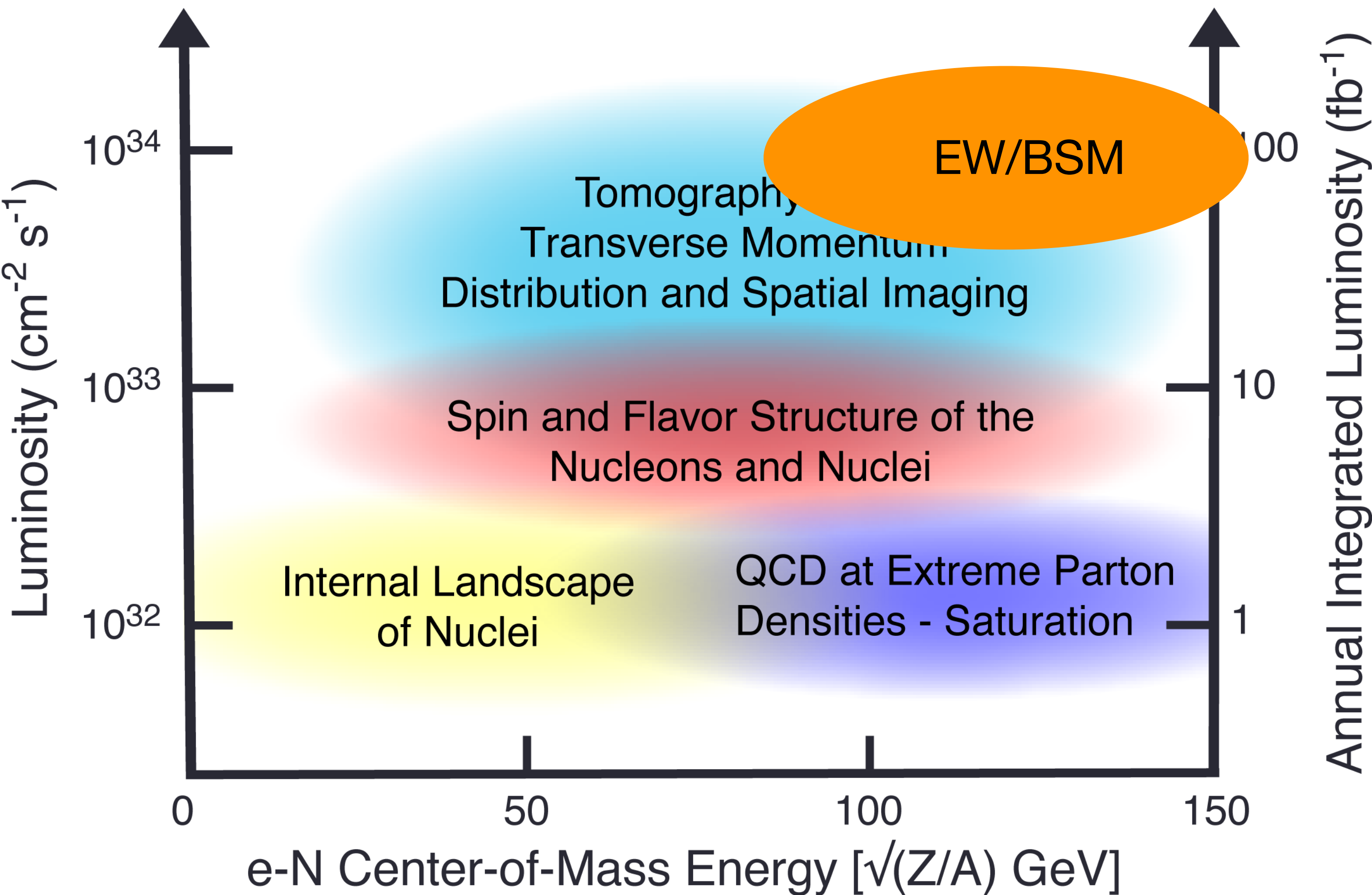
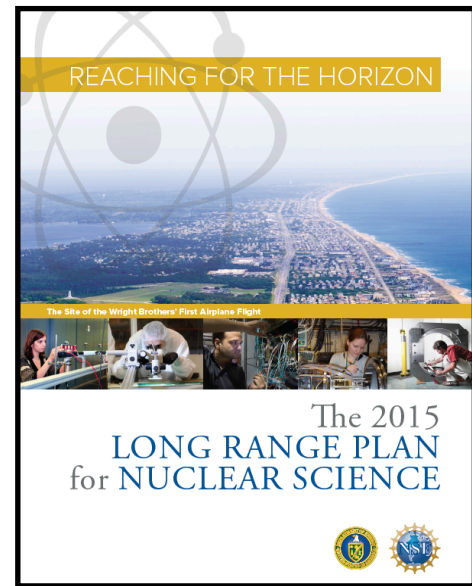
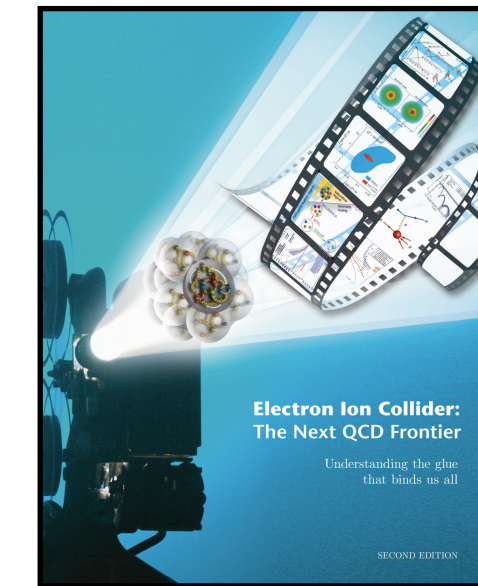
EIC Science Compelling, fundamental & timely



The *main thrust* of EIC science on QCD: Role of Gluons

- Structure & dynamics (including spin) inside hadrons: Origin of mass & spin: Imaging
- Interaction of color in cold QCD matter (nuclei): color neutralization & hadronization
- Partons in nuclei: modification w.r.t. free nucleons & search for novel saturated gluons matter

Aware of Physics beyond QCD but it was not critical for the NSAC's *recommendation* for the EIC



We were aware other physics was possible:

- A state of the art **high-energy** and **high-luminosity** collider
- A **state-of-the-art** detector
- A **well integrated** IR/Detector

Why not explore EW and BSM physics possible?

- Electroweak probes to explore QCD
- $\sin^2\theta_W$
- Lepto-quarks

This workshop is also timely & important

- A [Yellow Report initiative](#) by the [EIC Users Group](#): The Yellow Reports expected to inform the **Technical Design Report (TDR)** for the detector & IR
- Revisit some of the earlier identified interests but also explore others (as reflected in the agenda) in the EW and BSM domain with a *better understanding of the machine parameters and timeline*
- If some new ideas seem promising **influence the machine, IR and detector design to enhance the EIC physics program**

Such ideas being explored globally

- LPC Workshop on [Physics Connections between LHC & EIC](#): 3-day meeting November 13-15, 2019 at FNAL : Synergies between HEP and EIC/NP common interests (Organizers: A. Deshpande, T. Hobbs, J. Qiu, R. Yoshida, R. Boughezal, J. Campbell, O. Evdokimov, S. Hoeche, F. Petriello)
- Precision QCD, Monte Carlo event generators, lattice QCD, advance computing, opportunities in Electroweak sector & BSM searches
- [SnowMass2021](#) organized by DPF, for the HEP community to come together to identify & document a vision for the future of particle physics in the US with International partners. (Y-K Kim, T. Han, J. Butler & P. Cushman)
- **Important to connect with them. There is interest in EIC science and the novel accelerator physics ideas.**

**Before we begin the main program
a slide and a few comments by
Swagato Mukherjee
One of the conveners of the SnowMass21**

- Snowmass 2021: community driven whitepaper preparations for HEP long-range plan
 - organized: Division of Particles and Fields (DPF), American Physical Society (APS)
 - <https://snowmass21.org/start>
- EF07: QCD and strong interactions: Heavy Ions — topical group within Energy Frontier; included for the first time
 - <https://snowmass21.org/energy/start>
 - Yen-Jie Lee (MIT, yen-jie.lee@cern.ch) & Swagato Mukherjee (BNL, swagato@bnl.gov)
- heavy-ions topical group will also explore, identify and document opportunities for HEP@EIC
- letters of interest: couple of pages document to inform conveners about community's interest in different topics
 - <https://snowmass21.org/loi>
- sign up for mailing list SNOWMASS-EF-07-HEAVY-IONS@FNAL.GOV
 - <https://snowmass21.org/energy/start#communications>